Geomagnetic Storm Forecast Accuracy

Measure Updated: 06/30/2010	FY11 Target	FY12 Target	FY13 Target	FY14 Target	FY15 Target	FY16 Target
Revised (FY10 AOP/FY11 PB)	30%	40%	40%	45%	50%	50%

Description of Measure: Geomagnetic Storm Forecast Accuracy is the percentage of days that a geomagnetic storm event at Earth was successfully forecast by the Space Weather Prediction Center (SWPC). The annual goal represents a minimum percentage of cases for which a Geomagnetic Storm Forecast was successfully issued by the SWPC and verified over the following 48 hour period. Geomagnetic storming is generally caused by an Earth-directed Coronal Mass Ejection (CME) at the sun which interacts with and disturbs the geomagnetic field of the Earth. Most of the CME's that result in geomagnetic storms arrive at earth 36-72 hours after they are observed at the sun (although times as short as 18 hours have been observed in extreme cases). The geomagnetic storms associated with shorter CME transit times are generally the storms that have the most significant effect at Earth. For that reason, this measure focuses on the one and two day forecast accuracy, narrowing the performance measure to the most significant geomagnetic storm events.

For Solar Cycle 23 (May 1996 – December 2008) the Geomagnetic Storm Forecast Accuracy was found to be 30%. During this cycle, SWPC forecasters issued approximately 30 Geomagnetic Storm Forecasts per year during the most active periods and few or no Geomagnetic Storm Forecasts during the solar minimum years.

In FY 2011-2012 SWPC will be transitioning a physics-based solar wind model which will provide guidance to forecasters as to the size, location, and speed of CME's. This guidance is expected to improve estimates of CME arrival times at Earth over what is possible today with current forecasting techniques. This will lead to increased accuracy of the Geomagnetic Storm Forecasts .

Natural Variability: The number of geomagnetic storms varies from year to year during the approximately 11-year solar cycle. During the peak of solar activity, or solar maximum, significant geomagnetic storming is likely to occur regularly. During the lull in solar activity, or solar minimum, long periods of time are likely with little to no geomagnetic storming. For this reason, yearly changes in this measure may not be as significant as longer term trend measurements that span the natural solar cycle. The next solar maximum is expected in 2013.

Discussion: Methods to improve performance for FY11-FY16:

- Enlil Solar Wind Model Deployment
- Forecaster Training and Improved Model Interpretation and Application
- Enlil Solar Wind Model Continuing Validation and Improvement
- Interpretation and Application of NASA Solar Terrestrial Relations Observatory (STEREO) Observations (finite mission lifetime due to nature of orbit)

Additional Information:

- For this metric a geomagnetic storm is defined as an event equal to or exceeding the Minor Storming level as defined by the Daily Geomagnetic A-index ≥ 30 (equivalent to Geomagnetic K-index ≥ 5 or $\geq$ G1 Level on the NOAA Space Weather Scales).
- To account for solar cycle variability and to maintain statistical significance, this metric will be assessed over either a minimum of a fiscal year or the 30 most-recent geomagnetic storms (during periods of solar minimum).
- FY12 target has the largest increase because of significant improvements anticipated as the Enlil solar wind model becomes operationally used by SWPC forecasters. Delays in this implementation will affect the final overall metric.
- A coronagraph on Deep Space Climate Observatory (DSCOVR) or suitable equivalent is required to maintain current operational capabilities and is necessary for the improvements targeted above; the lack of a coronagraph will impede progress in geomagnetic storm warning accuracy and in the worst case, decrease performance in this metric.
- Solar observations on DSCOVR, the Advanced Composition Explorer (ACE) follow-on at the L1 Lagrangian point, as well as solar observations at the L5 Lagrangian point, will provide for more accurate input to the Enlil model and the potential for improved forecast metrics